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ABSTRACT

Research has identified three reading strategies that are affected in various ways by signaling--the emphasis of superordinate relationships in text. Using a structure strategy, readers follow the text's superordinate relations to focus on the text's message and how it relates to supportive details. Readers who use the detail/list strategy focus on learning facts; they develop a flat, list-like structure instead of developing hierarchical structures of interrelationships among major text propositions. In contrast to these two systematic strategies, the default/list strategy represents no systematic plan. The type of signaling studied in relation to these three strategies explicitly cued superordinate text structures. Such explicit signaling promoted a switch from the detail/list to the structure strategy; thus, it dramatically affected protocol organization and types of information recalled. Explicit signaling also facilitated the substitution of the structure strategy for the default/list strategy, increasing recall in those readers making the switch. It did not appear to influence readers who already were using the structure strategy. (RL)

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Signaling in Text and Its Interaction with Reader Strategies

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Signaling in Text and Its Interaction
with Reader Strategies

People cannot remember everything from what they read. Capacity limitations dictate selectivity in processing and forgetting information. An important educational issue centers on how readers determine what information is important to remember from text. This process frequently is guided by structure and emphasis in text. Manipulations of text structure, emphasis devices, and their interactions affect reader strategies for selecting types of information to remember. This paper examines the interaction between reader strategies and hierarchically organized text which varies in emphasis placed on its overall superordinate structure.

Background Definitions

Text structure specifies the interrelationships among text information as well as subordination and coordination of this information (Meyer, 1975, 1977, 1979). Thus, text structure provides an organizational structure for understanding information and judging its importance. Figure 1 depicts the superordinate conceptual structure of an article about supertankers. Propositions at the top-third of the total text analysis correspond to what has commonly been called a text's message; the middle third corresponds to major details which support the premises of the message and the bottom third corresponds to minor details (Meyer, 1979; Meyer, Brandt, & Bluth, Note 1). The structure, depicted from the author's perspective, highlights the information interrelated by its superordinate structure, while it de-emphasizes information interrelated at lower levels (Meyer, 1975).

Insert Figure 1 about here

Emphasis devices, such as typography, graphics, questions, objectives and signaling, can parallel the importance hierarchy of the text structure or highlight information from lower levels in the structure. As seen in Table 1, variations in the match between structure and emphasis differentially affect the reading performance of students with different reading skill levels (Meyer, in press). The present paper deals only with well-organized, hierarchically structured exposition where structure and emphasis, namely signaling, are compatible (see the first column in Table 1).

Insert Table 1 about here

Signaling has been defined as information in text which does not add new content on a topic, but which gives emphasis to certain aspects of the semantic content or points out aspects of the structure of the content (Meyer, 1975). The types of signaling identified included explicit statement of the structure of relations in the text structure, preview statements, summary statements, and pointer words or evaluative signaling. The studies to be reported in this paper only involve signaling of the first variety, the structure of relationships, and only signaled relationships located at the top half of text structure.

The relationships which occur at this superordinate level in the structure are rhetorical relationships: comparison, causal, description, collection, and problem/solution (response). (For examples, refer to Figure 1.) Signaling of these relationships explicitly points them out to readers; examples of signaling for comparison relationships include "in contrast," "however," "but," and "on the other hand" and for causal relationship,

they include "therefore," "as a result," "so that," "in order to," and "because." (Also, see Appendix A for examples.) If signaling is not provided by a writer, then the reader must infer an appropriate logical relationship among propositions. The type of signaling investigated in this paper is parallel to Halliday and Hasan's (1976) conjunction cohesion; however, it is examined at the macroproposition level where it interrelates groups of sentences and paragraphs rather than clauses and sentences at the microproposition level of text structure.

Signaling and Strategy Effects on Recall

Signaling which emphasizes these superordinate relationships appears to affect various types of readers in different ways. The dominant reading strategy employed by groups of readers appears to interact with signaling effects. First, three reading strategies identified in our research will be presented. Then models of the interaction between these strategies and signaling will be examined along with relevant data. In this manner, I will attempt to make sense out of studies of signaling effects with disparate findings. Although data based, the interpretations are speculative and will require further empirical verification.

Strategies: The reading strategies for determining what is important to learn and remember from text are listed below. Each has been identified as a dominant or preferred strategy by different populations sampled in our research. The first is the dominant strategy of proficient readers at the high school and college level. The second is the preferred strategy of college-educated older adults who are no longer attending school. The third is the dominant strategy of high school and junior college students with adequate word attack skills, but poor reading comprehension skills.

The three strategies are probably automatically employed by most of the readers in these groups.

I. Structure Strategy: Follow the text's superordinate relational structure--focus on the text's message and how it relates to supporting major details

II. Detail/List Strategy: Learn the facts--focus on minor details (i.e., propositions whose arguments are names and numbers)

III. Default/List Strategy: No systematic plan

A strategy which will not be discussed is that of a reader, such as an expert on a passage topic, who provides a hierarchical structure of relationships for understanding the text different from that given in a well-organized text (Meyer & Freedle, Note 2). Although this strategy is of theoretical and practical interest, little relevant data exist due to infrequent occasions for its use in typical prose learning studies.

Strategy I has been substantially documented in recent years. Its outcome is superior recall of information high in the text structure over low level information (Kintsch & Keenan, 1973; Mandler & Johnson, 1977; Meyer, 1971, 1975, 1977, 1979; Meyer & McConkie, 1973; Thorndyke, 1977); it has been termed the levels effect (Kintsch & van Dijk, 1978). Also, the superordinate relational structure of the recall protocols produced by deployment of this strategy is similar to that of the text (Meyer, 1979; Meyer & Freedle, Note 2). That is, both the protocol and original text have the same top-level structure (such as problem/solution--see Figure 1) and most of the same major supporting relationships (such as the causal

and comparison relationships in Figure 1). This strategy is also related to comparatively high levels of overall recall (Meyer, 1979).

Processing activities hypothesized for the structure strategy are similar to explanations given for the levels effect by Anderson (1976) and Kintsch and van Dijk (1978), only primary emphasis is placed on a search for interrelationships among chunks of complex propositions in text. Anderson (1976) explained that high level propositions, central propositions in the network of this computer simulation model, are more frequently called up to help interpret the more peripheral low level propositions. This constitutes extra rehearsal of high level propositions and results in increasing the probability of their recall. Similarly, Kintsch and van Dijk (1978) explained that high level propositions are processed differently than low level propositions. High level propositions are hypothesized to be more frequently retrieved from long-term memory and kept in the short-term memory buffer as old propositions to be related to incoming new propositions in the reading process. In the Kintsch and van Dijk (1978) model, high level propositions are identified by repetition of arguments or concepts. The model does not specify how the extreme superordinate proposition is identified; this proposition is crucial since repetition of its arguments dictate moving down in the hierarchy and building the text structure. At present the superordinate proposition is selected on an intuitive basis with the expectation that further work with their macroprocesses component will help to explicate this choice.

The superordinate rhetorical relationships in text along with readers' prior knowledge of them appear to play a crucial role in comprehension (Bartlett, 1978; Meyer, 1979) and must be integrated more fully into the

macroprocesses component of the Kintsch and van Dijk model. High level propositions need not be identified solely on argument repetition, but they can be identified as the arguments of the major rhetorical relationship or top-level text structure. The extreme superordinate proposition is then identified as the content bound by the top-level structure. For example in the first paragraphs of the passage reproduced in Appendix A, the extreme superordinate proposition is oil spills. It is explicitly signaled as the problem in the first sentence of this passage, which is written with a problem/solution top-level structure commonly found in scientific articles. Thus, a focus on relationships and top-level structures can be used to specify the superordinate proposition in a structural analysis.

Processing activities for the structure strategy focus on a search for major text-based relationships among propositions. That is, there is a search for relationships which can subsume all or large chunks of this information and tie it into a summarized comprehensible whole. Readers employing the structure strategy are hypothesized to approach text looking for patterns that will tie all the propositions together and the author's primary thesis which will provide the content to be bound by these patterns or schemata. Then, they search for relationships among this primary thesis and supporting details. For example, when reading the supertanker text they recognize in the first sentence that the propositions may fit their problem schema. Each new proposition is related back to the problem, making the problem of oil spills from supertankers continually selected for retention in the short-term memory buffer for interpreting the new propositions. Previous knowledge about problems keeps the readers searching for causal relationships among

descriptive information about the problem, such as why it is a problem and what caused it. Also, prior experience with problems leads readers to anticipate and search for solutions, solutions which must satisfy most of the previously stated causes of the problem. Thus, the problem and its causes are retrieved continually from long-term storage to the short-term memory buffer for relating to the subsequent propositions in the passage. This additional processing of these superordinate propositions and their interrelationships increases the depth with which they are processed (Craik & Lockhart, 1972) and the subsequent ease with which they can be retrieved. The top-level structure and major interrelationships are also employed by strategy I students to guide retrieval and production of the recall protocol; it is hypothesized to a top-down retrieval search guided by the structure of relationships.

In contrast to the structure strategy, readers utilizing the detail/list strategy do not focus on superordinate text structure. Instead of developing a hierarchical structure of interrelationships among major propositions, they develop a flat, list-like structure. This list is a collection of complex propositions which describe the passage topic; the list contains the main idea as one of these propositions, and an unusually high proportion of propositions from low in the structure. These readers seem to focus on propositions whose arguments are numbers, dates, and names. Evidence for the existence of this strategy comes from the performance of middle and old adults on a passage without signaling (Parakeets: Ideal Pets--Meyer, 1975) as shown in Figure 2 (Meyer, Rice, Knight, & Jessen, Note 3).

Insert Figure 2 about here

These older adults did not differ in total free recall nor number of correctly answered questions from a comparable group of young adults, but did differ in the type of information recalled ($F_{2, 41} = 4.93$, $p < .01$). In this study the levels effect on the recall task was only statistically significant for young adults.

Strategy II, the detail/list strategy, could result from deficits associated with aging, such as deficits in use of organization (Craik, 1968, 1977) or increased distractibility (Rabbitt, 1965). Alternatively, the strategy may be explained by culturally related generational differences (Perlmutter, 1978; Schaie, 1970). For example, use of strategies I and II may relate to differences in pedagogy between contemporary schooling and past schooling. That is, greater emphasis in the past may have been placed on rote learning and mastery of details.

Strategies I and II are systematic plans for processing text. However, strategy III is the default approach. The reader has no focus and simply tries to remember something from the text.

Interaction of signals and strategies: Figure 3 presents the scheme which will be used to examine signaling effects for subjects varying on these three reading strategies. The presence or absence of signaling appears to have minimal effects on subjects employing the structure strategy. It does not influence the way they organize their recall protocols, the amount of information recalled, nor the type of information recalled (Marshall & Glock, 1978-79; Meyer, 1975, 1979, in press; Meyer, Brandt, & Bluth, Note 1). In addition, as seen in Table 2 under young adults, it

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Insert Figure 3 about here

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does not affect their ability to answer questions tapping the signaled structural relationships. Although it does not affect reading speed, it does appear to affect cognitive capacity as measured by reaction time to a secondary task (reactions to random clicks while reading text with and without signaling, Britton, Meyer, & Penland, Note 4). Subjects utilizing the structure strategy included most ninth graders with high reading comprehension test scores (Meyer, Brandt, & Bluth, Note 1) and most students attending undergraduate and graduate colleges (Britton, Meyer, & Penland, Note 3; Marshall & Glock, 1978-79; Meyer, 1975, 1979, in press). As depicted in Figure 3, it appears that these readers follow the same reading strategy regardless of the presence of signaling; that is, they follow the text structure as a framework for understanding the text and a basis for apportioning processing time to its component propositions.

Insert Table 2 about here

For subjects whose dominant strategy is the detail/list strategy, signaling does not affect the amount of information recalled nor reading speed, but it does affect the type of information recalled (see Table 3) and the organization of the recall protocol (see Table 4). In addition, as seen in Table 2 under old adults, it also affects their ability to correctly answer questions about the major interrelationships among ideas in text. This may be due to their inability to generate many of these

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Insert Tables 3 and 4 about here

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relationships on their own without explicit signals in the text. This would make the detail strategy merely the result of an inability of strategy I subjects to figure out structure without the aid of signaling (see the path with dashes under structure strategy in Figure 3). However, the difference in question performance may be a result of preoccupation with processing details rather than an inability to generate logical relationships. This seems the more plausible explanation for the middle-aged adults (see Table 2 data for middle-aged adults; Meyer & Rice, Note 5).

Readers employing the default/list strategy III are affected differentially by signaling. Subjects identified as using this strategy include students (ninth grade and junior college) whose word attack skills are adequate, but who have deficient reading comprehension skills (Marshall & Glock, 1978-79; Meyer, Brandt, & Bluth, Note 1). For this group signaling appears to give them an organized strategy for learning and remembering text which they ordinarily lack. Their total recall scores are improved; this is the only group where total recall scores appear to be affected by signaling. For example, with a group of 26 ninth graders identified as underachievers in reading comprehension (comprehension test scores on the Stanford Achievement Test at least one stanine below their vocabulary scores), the presence of signaling in the supertanker passage (see Appendix A) significantly increased their immediate free recall scores ($\bar{X}$ = 48 with signaling, $\bar{X}$ = 33 without signaling). Also, Marshall and Glock (1978-79) found improved total recall of junior college students with the presence of signaled text relationships.

In summary, in order to predict the effects of signaling superordinate text relationships, the dominant strategy for the targeted readers must

be identified. If the dominant strategy is the structure strategy depicted in Figure 3, then signaling will not yield readily observable effects since the dominant reader strategy will not be changed. However, if the dominant strategy for a group of readers is the detail/list strategy, then signaling will dramatically affect protocol organization and types of information recalled since it promotes a switch from their dominant strategy to the structure strategy. For poor comprehenders with adequate decoding skills signaling gives them the structure strategy in place of a random, non-systematic approach. For these readers signaling is an aid which increases the amount of information remembered. These findings have implications for instruction and the design of textbooks.

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Table 1

Relationships Between Reading Skill of Student and Match Between Structure of Hierarchically Organized Text and Emphasis Device (Signaling, Typography, Graphics, Objectives, Questions, and Illustrations)

Reading Skill of Student	Content Highlighted by Text Structure and Emphasis Device	
	Match	No Match
Proficient	0[a] No Effects	+[b] Effects
Poor in Comprehension/ Adequate in Decoding	+ Effects	+ Effects
Poor in Comprehension and Decoding	0 No Effects	0 No Effects

[a] 0 = no differences in recall between text with and without signaling.

[b] + = differences in recall between text with and without signaling.

Table 2

Effects of Signaling Superordinate Text Relationships on Performance on 20 Short Answer Questions About These Relationships for Young (18-32) and Old (62+) Adults

Age Groups		Signaling: With-Signaling	Signaling: Without-Signaling	Significance Levels
Young (18-32)	$\bar{X}$	12.00	10.60	$F_{1, 25} = .86$ n.s.
	SD	3.56	3.90	
	N	12	15	
Middle (40-54)	$\bar{X}$	13.33	10.78	$F_{1, 16} = 2.81$ n.s.
	SD	2.58	3.46	
	N	9	9	
Old Adults (62+)	$\bar{X}$	11.00	7.95	$F_{1, 39} = 5.49$ $p < .05$
	SD	4.71	3.25	
	N	21	20	

Table 3

Mean Proportion of Idea Units Recalled from High, Middle, and Low in the Content Structure of the Supertanker Passage by Old Adults ($\bar{X}$ Age = 80, $\bar{X}$ Education = 14 Years) Who Read Passages With and Without Signaling

	Signaling	
Type of Information	With	Without
Message (High)	.67	.47
Major Details (Middle)	.31	.30
Minor Details (Low)	.09	.14

Table 4

Use of Hierarchical (Problem/Solution) Structure or List Structure in Recall Protocols Written by Old Adults ($\bar{X}$ Age = 80, $\bar{X}$ Education = 14 Years) After Reading Passage With and Without Signaling

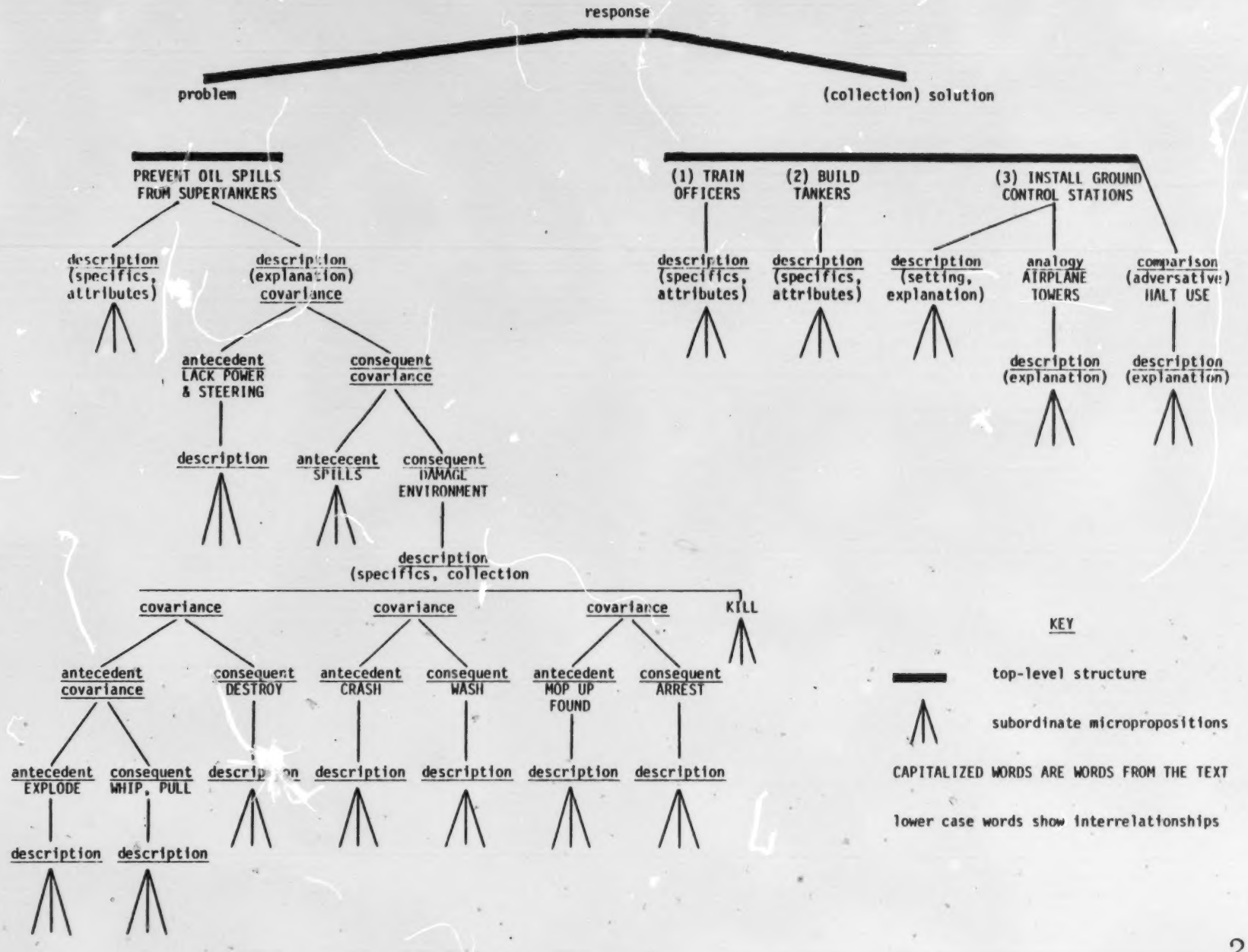
		Structure of Protocol	
		Hierarchical	List
Signaling	With	9	1
	Without	5	5

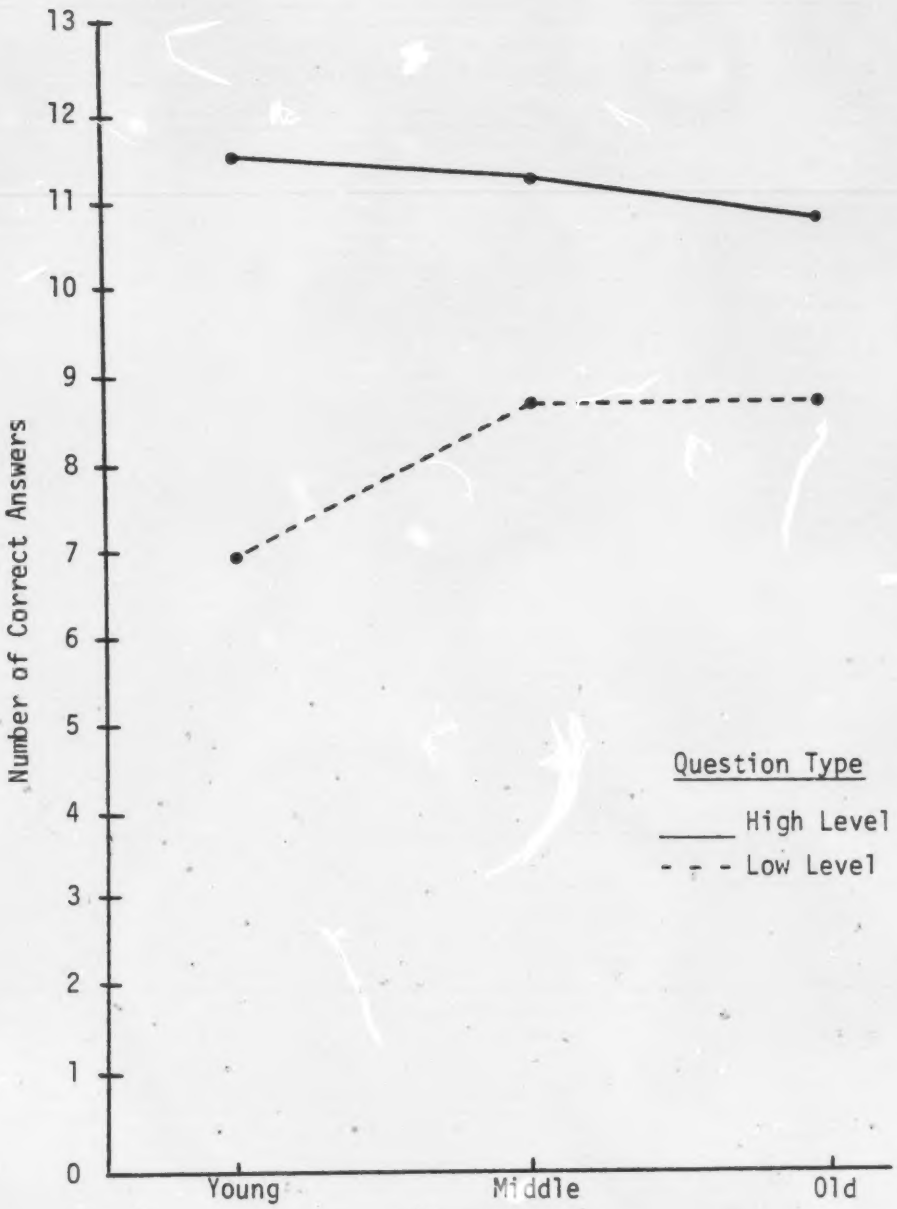
Figure Captions

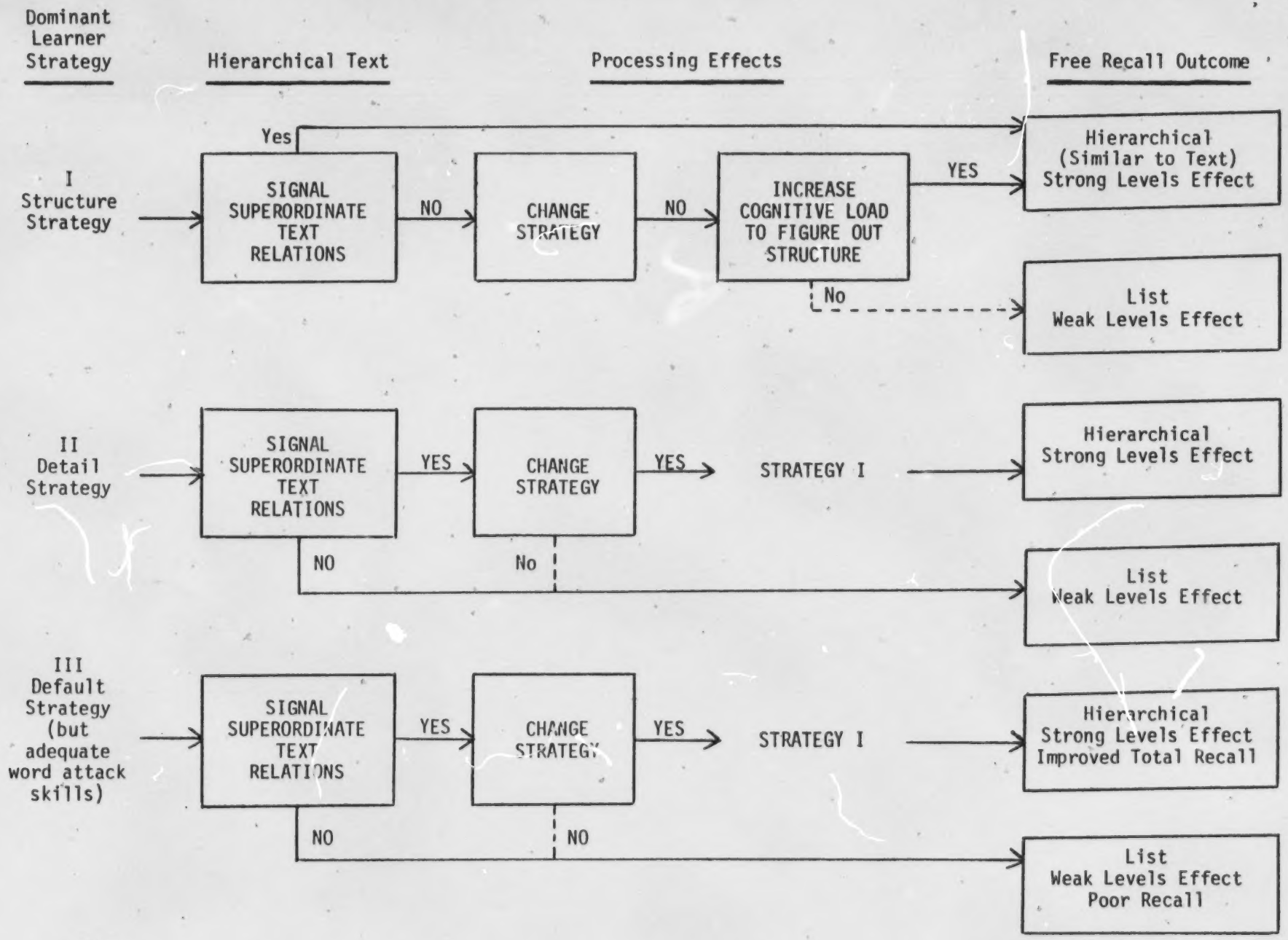
Figure 1. Superordinate structure of relationships of a magazine article on supertankers.

Figure 2. Number of correct answers given by young, middle, and old adults to high and low level questions taken from a passage without signaling.

Figure 3. Model depicting the interaction of reader strategies and signaling in text.


response
problem
(collection) solution
PREVENT OIL SPILLS FROM SUPERTANKERS
(1) TRAIN OFFICERS
(2) BUILD TANKERS
(3) INSTALL GROUND CONTROL STATIONS
description (specifics, attributes)
description (explanation) covariance
description (specifics, attributes)
description (specifics, attributes)
description (setting, explanation)
analogy AIRPLANE TOWERS
comparison (adversative) HALT USE
antecedent LACK POWER & STEERING
consequent covariance
description (explanation)
description (explanation)
description
antecedent SPILLS
consequent DAMAGE ENVIRONMENT
description (specifics, collection
covariance
covariance
covariance
KILL
antecedent covariance
consequent DESTROY
antecedent CRASH
consequent WASH
antecedent MOP UP FOUND
consequent ARREST
antecedent EXPLODE
consequent WHIP, PULL
description
description
description
description
description
description
description
KEY
top-level structure
subordinate micropropositions
CAPITALIZED WORDS ARE WORDS FROM THE TEXT
lower case words show interrelationships


13
12
11
10
9
8
7
6
5
4
3
2
1
0
Number of Correct Answers
Young
Middle
Old
Question Type
High Level
Low Level


Dominant Learner Strategy
Hierarchical Text
Processing Effects
Free Recall Outcome
I Structure Strategy
Yes
SIGNAL SUPERORDINATE TEXT RELATIONS
NO
CHANGE STRATEGY
NO
INCREASE COGNITIVE LOAD TO FIGURE OUT STRUCTURE
YES
Hierarchical (Similar to Text) Strong Levels Effect
No
List Weak Levels Effect
II Detail Strategy
SIGNAL SUPERORDINATE TEXT RELATIONS
YES
CHANGE STRATEGY
YES
STRATEGY I
Hierarchical Strong Levels Effect
NO
No
List Weak Levels Effect
III Default Strategy (but adequate word attack skills)
SIGNAL SUPERORDINATE TEXT RELATIONS
YES
CHANGE STRATEGY
YES
STRATEGY I
Hierarchical Strong Levels Effect Improved Total Recall
NO
NO
List Weak Levels Effect Poor Recall

Appendix A

A signaled version of the supertanker passage:
Signaling shown with italics and overall
structure depicted in Figure 1

Some Solutions for the Supertanker Problem

A *problem* is prevention of oil spills from supertankers. *Attributes* of a *typical* supertanker include carrying capacity of a half-million tons of oil, size of five football fields, and cargo areas easily accommodating the Empire State Building. *The trouble is that* a wrecked supertanker spills oil in the ocean. *As a result of spillage* the environment is damaged. *An example* took place in 1970 near Spain when an oil spill from a wrecked tanker exploded into fire. *The fire caused* hurricane-force winds which whipped the oil into a mist and pulled all of it high into the air. Several days later black rain *resulting* from this oil spill destroyed crops and livestock in the neighboring villages. *Another example of damage* occurred in 1967 when the tanker, Torrey Canyon, crashed off the coast of Cornwall and *resulted* in the washing ashore of 200,000 dead seabirds. *An example* which happened nearer to home came to pass in July 1975 when the United States Coast Guard mopped up acres of oil from the beach at Geiger Key, Florida, north of Key West. Guardsmen found chemical clues *which led to* the arrest on November 7, 1975 of a Greek tanker captain, Vasilios K. Psarroulis, *because of* failure to report the loss of an estimated 40,000 gallons of oil. Oil spills *also* kill microscopic plant life *which* provide food for sea life and produce 70 percent of the world's oxygen supply.

Most wrecks result from the lack of power and steering equipment to handle emergency situations, *such as* storms. Supertankers have only one boiler to provide power and one propeller to drive the ship.

The *solution to the problem is not* to halt the use of tankers on the ocean *since* about 80 percent of the world's oil supply is carried by supertankers. *Instead, the solution lies in the following three tactics. First,* officers of the supertankers must get top training in how to run and maneuver their ships, *such as that* provided by the tanker simulator at the Maritime Research Center. *Second,* tankers should be built with several propellers for extra control and backup boilers for emergency power. *Third,* ground control stations should be installed at places where supertankers come close to shore *because* they would act like airplane control towers, guiding tankers along busy shipping lanes and through dangerous channels.